



EXPLORATION TOWARD IMPLEMENTATION OF MANAGEMENT PROCEDURES WITH QUALITATIVE/ SEMI-QUANTITATIVE RISK ASSESSMENT APPROACH FOR DATA-POOR BYCATCH SPECIES RELEVANT TO THE IOTC FISHERIES

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Purpose, expectation and action intended (select one or more and include corresponding text)

To introduce the concept of Ecological Risk Assessment for the Effect of the Fishing (ERAEF) that largely rely on qualitative and semi-quantitative analysis to identify the extent of impacts of fishing activities to bycatch and ecosystem, and to propose a work plan to examine the applicability and feasibility of the approach in the context of risk evaluation of data-poor species in the IOTC context.

Discussions (for information and open discussion):

This paper is to inform an alternative way in implement monitoring and managing the IOTC fisheries impact on data-poor species and ecosystem and seeks for a consideration on exploring the potential benefits, pros and cons and feasibility when utilising in the IOTC context. [The paper is to inform meeting members that..., as set out in Section X]

Feedback (to collect input and suggestions)

The document is to seek for a consideration on work plan described in the last two sections.

Conclusion (to record a concluded position or summary)

The approach follows the principle of ecosystem-based approach for fisheries management, and the whole processes seems well organized but quite simple and easy to understand. It is worth examining the applicability and feasibility of the approach to monitor and evaluate the extent of impacts of IOTC fishing on bycatch and ecosystem where it is difficult to collect adequate information for quantitative assessment. [The paper is to seek confirmation that..., as set out in Section X]

Recommendation (to ask the meeting to endorse a recommendation)

The document seeks for a consideration of proposed 3 years work plan in evaluating the applicability and feasibility of the Australian ERAEF in the IOTC context.

Decisions (to request formal approval of actions)

The document seeks for a consideration of proposed 3 years work plan in evaluating the applicability and feasibility of the Australian ERAEF in the IOTC context.



Abstract

This document introduces the concept utilized in the Australian risk assessment processes, Ecological Risk Assessment for the Effects of Fishing (ERAEF), largely relying on qualitative and semi-quantitative analyses through stakeholder consultations to rank the impacts on fishing activities on species and ecosystem. The document proposes a work plan to examine the applicability and feasibility of such approaches in the IOTC context, in particular for monitoring and management of data-poor bycaught species, using manta rays as focused species and through test-case application of the first two processes in a limited number of relevant CPCs.



Exploration toward implementation of management procedures with qualitative/ semi-quantitative risk assessment approach for data-poor bycatch species relevant to the IOTC fisheries

Sachiko TSUJI

Introduction:

Discussion at the second meeting of Indian Ocean Shark Research Plan workshop held in Cape Town, South Africa, 28–30 July 2026, provided a rare opportunity to overview the current situation and existing issues that the IOTC shark management is facing. Substantial parts of catch have been taken in the coastal areas where monitoring and data collection are troublesome due to involvement of large number of small and diversified operational units broadly scattering along the coast. At the same time, the fishery management authorities including tuna RFMOs are under the continuously increasing pressure to take responsibility more actively in controlling and mitigating the impacts of their fishing to the vulnerable species and ecosystems. Noting expected deterioration of reliability in longline CPUE and little prospects in drastic improvement of monitoring capacity for coastal fisheries, the author believe it essential for seeking alternative way of monitoring and managing the data-poor species, in parallel to the efforts of improving assessment procedures and data availability.

Australia initiated its efforts in implementing the ecosystem-based fishery management in the 1990s, largely relying on qualitative and semi-quantitative risk assessment through stakeholder consultations, and succeeds in establishing bycatch strategy including risk assessment of large number data-poor species.

This document introduces the concept utilized in the Australian risk assessment processes and proposes a potential work plan to examine the applicability and feasibility of such approaches in the IOTC context, in particular for monitoring and management of data-poor bycaught species. The document was prepared in a rush, mainly based on the past exercises, since the author currently has a limited accessibility to scientific journals, and therefore the references should not be considered as the most updated nor comprehensive.

Also, it should be noted that the document reflects only the author's personal view and that there is no linkage with the consideration and priority of the Japanese government.

Ecological Risk Assessment for the Effects of Fishing (ERAEF)

Australian bycatch management guideline established through the Commonwealth Fisheries Bycatch Policy managed by the Department of Agriculture, Fisheries and Forestry (DAFF) indicates three principles, i) ecosystem approach by integrating whole policy within the broader Ecologically Sustainable Development (ESD) objectives, ii) pragmatic approach by pursuing mitigation options that are cost-effective and operationally feasible for fishers, and iii) minimizing impact of fisheries by reducing incidental catch of non-targeted species, including finfish, marine mammals, reptiles, and seabirds. In order to achieve this, it first conducts the Ecological Risk Assessment for the Effect of Fishing (ERAEF) to evaluate and rank the impact of fishing operations on different bycatch species group, followed by establishment of Bycatch Action Plans (BAPs), set of fishery-specific and enforceable plans including detailed gear restrictions and mitigation measures, and then with their implementation, monitoring and reporting.



The first step, ERAEF, is a hierarchical framework to evaluate and manage the impacts of fishing operations including commercial fisheries on marine ecosystems, developed primarily by the Commonwealth Scientific and Industrial Research Organisation (CSIRO) in partnership with the Australian Fisheries Management Authority (AFMA).

ERAEF uses a stepped approach starting with broad overview to detailed quantitative analysis. The four steps included are:

- Scoping: gathering information on fisheries activities and operational details and mapping them against various ecosystem components including species and habitats.
- Level 1 (SICA - Scale, Intensity, Consequence Analysis): ranking likelihoods and consequences of each hazards/ risks/ fishing impacts for identifying the risks with relatively high impacts and filtering out the risk with low/ negligible impacts, using qualitative and semi-quantitative approach.
- Level 2 (PSA - Productivity and Susceptibility Analysis): evaluate and rank vulnerability individual species, habitats, and communities based on their biological characteristics and susceptibility to fishing, based on semi-quantitative approach. Only those identified with significant impacts will become subject to this level of analysis
- Level 3 (Quantitative Analysis): full quantitative assessment for those identified as high-priority, high-risk components in earlier steps.

Whole processes include heavy involvement of stakeholder consultations such as managers, fishers and local communities for ensuring the management solutions to be pragmatic and operational and management goals in accordance with stakeholders' requirements.

While Hobday *et al* (2007) is a manual of whole ERAEF process, with focus on the processes up to Level 2 with many examples, Fletcher (2005) provides the conceptual overview and principles only for the first two processes. Fletcher (2015) is a review on issues and refinement of terminologies, good supplement to understand the potential issues. This document also only covers the first two processes that would require as the initial step when implementing ecosystem-based fishery management (EBFM) regardless the concrete management objectives.

Scoping:

The aim in the Scoping stage is to develop a profile of the fishery being assessed. The tables¹ need to complete at this stage include General Fishery Characteristics (S1), Unit list (target, byproduct/bycatch, TEP, habitats, communities) (S2), Identification of Objectives (S3) and Hazard identification (S4).

Contents to be fulfilled for each table include (not comprehensive, please consult with the original document for the details):

S1: General Fishery Characteristics

- General Characteristics: fishery name, start date/history, geographic extent, fishing season, target species and stock status, bait collection and usage, current entitlement, current and recent TACs, quota trend, current and recent effort trend, current and recent catch trend, current and recent value (\$) of fishery, and relation with other fisheries

¹ Reference of tables follows the Hobday *et al* (2007).



- Gear: fishing gear and method; gear restrictions; selectivity of gears and fishing method; spatial gear zone set; depth range gear set; how gear set; area of gear impact per set or shot; capacity of gear; effort per annum all boats; lost gear and ghost fishing;
- Issues: target species issues; byproduct and bycatch issues and interactions; TEP issues and interactions; community issues and interactions; discarding;
- Management (planned and those implemented): management objectives; fishery management plan; input controls; output controls; technical measures; regulations; initiatives and strategies; enabling processes; other initiatives or agreements;
- Data: logbook data; observer data; other data

S2: Identification of unit

- Identification of Units - Species: for each fishery, list all species separated by target, byproduct/ bycatch, TEP, discards (excluding TEP)
- Identification of Unit - Habitats:
 - Substratum: 0-Mud (soft) (approx. <0.1mm); 1-Fine sediments (soft) (approx. 0.1-1mm); 2-coarse sediments (soft) (approx. 1-4mm); 3-gravel/pebble (hard) (approx. 4-60mm); 4-cobble/boulder/slab (hard) (approx. 60mm – 3m); 5-igneous/metamorphic rock (>3m); 6-sedimentary rock (>3m); 7-biogenic; X-not described;
 - Geomorphology: 0-unrippled/flat; 1-current rippled/directed sour; 2-wave rippled; 3-irregular; 4-debris flow/rubble banks; 5-subcrop; 6-low outcrop (no holes or cracks); 7-low outcrop (with holes and cracks); 8-high outcrop (no holes or cracks); 9-high outcrop (with holes and cracks); X-not described;
 - Fauna: 0-no fauna; 1-large/erect sponges; 2-small/low sponges; 3-mixed faunal community; 4-crinoids; 5-octocorals (gorgonians, seawhips, soft corals); 6-low encrustings; 7-solitary/sedentary; 9-bioturbators; SG-seagrass communities; HC-hard corals; BV-bivalve beds;

S3: Identification of objectives:

Objectives must be identified for each sub-fishery, for each of the five ecological components (target, byproduct and bycatch species, TEP species, habitats, and communities). Management objectives need to be identified for each component (core objectives) and sub-component (operational objectives), with the latter expressed as limits to acceptable change (what is “acceptable” needs to be defined in each case). Core objectives (also called endpoints) identify what you are trying to achieve. Operational objectives (or measurement endpoints) are objectives stated in ways that can be measured.

The criteria for selecting ecological operational objectives for risk assessment are that they be biologically relevant; have an unambiguous operational definition; be accessible to prediction and measurement; and that the quantities they relate to be exposed to the hazards.

Table skipped

S4: Hazard identifications: For each fishery, scoring according to presence (1) or absence (0)

- Capture: bait collection; fishing; incidental behavior;
- Direct impact without capture: bait collection; fishing; incidental behavior; gear loss; anchoring/mooring; navigation/ steaming;



- Addition/ movement of biological materials: translocation of species (boat launching, reballasting); on board processing; discarding catch; stock enhancement; provisioning; organic waste disposal;
- Addition of non-biological materials: debris; chemical pollution; exhaust; gear loss; 5 navigation/ steaming; activity/ presence on water;
- Disturb physical processes: bail collection; fishing; boat launching; anchoring/ mooring; navigation/ steaming;
- External hazards (specify the particular example within each activity area): other capture fishery methods; aquaculture; coastal development; other extractive activities; other non-extractive activities; other anthropogenic activities;

Any hazards identified in S4 should go to Level 1 analysis.

Level 1 Scale, Intensity and Consequence Analysis (SICA)

Level 1 aims to identify which hazards lead to a significant impact on any species, habitat or community. For all hazards identified as -1 in S4, scoring temporal and spatial scale of hazard activities as follows:

- Spatial scale: 1 - <1nm; 2 - 1-10nm; 3 - 10-100nm; 4 - 100-500nm; 5 - 500-1000nm; 6 - >1000nm;
- Temporal scale: 1 – decadal (1 day every 10 years or so); 2 – every several years (1 day every several years); 3 – annual (1-100 days per year); 4 - quarterly (100-200 days per year); 5 – weekly (200-300 days per year); 6 – daily (300-365 days per year);

Then, choose the most vulnerable sub-component (target, byproduct/bycatch, TEP) against each hazard and the most vulnerable “unit of analysis (i.e. most vulnerable species, habitat type or communities) on the basis of expected highest potential risk for each ‘direct impact of fishing’ and ‘fishing activity’ combination, together with rationale.

After selecting the most appropriate operational objective (skip), score the intensity of hazard activity and their consequence to the selected most vulnerable component as follows:

- Intensity score: 1 – negligible; 2 – minor; 3 – moderate; 4 – major; 5 – severe; 6 – catastrophic;
- Consequence score: 1 – negligible; 2 – minor; 3 – moderate; 4 – major; 5 – severe; 6 – intolerable;

Then, add confidence score either low (1 – data exist, but is considered poor or conflicting/ no data exists/ disagreement between experts) or high (2 – data exist and is considered sound/ consensus between experts/ consequence is constrained by logical consideration).

Compilation of scoring and selection results will give the final SICA table. Based on these results, select hazards/ risks to move the Level 2 PSA analysis that will not be covered in this document. The proposed PSA contains many refinements in identifying the areas of overlaps and susceptibility and would be worth considering in future PSA analysis in the IOTC.

General observation

FAO Guidelines indicated four steps of implementing the ecosystem approach to fisheries, i.e. i) definition of broad objectives, ii) identification and prioritization of the issues to be addressed, iii) development of effective management system and measures, iv) formalizing management plan with appropriate monitoring of performance and communications. Australian approach to achieve their Ecologically Sustainable Development (ESD) (Fletcher, 2005, 2015) interestingly followed the above-mentioned steps, almost literally, through risk-management process. The ERAEF identified the issues/ impacts of fishing operations for individual fisheries first



thoroughly and systematically, then for each issue, determine a potential consequences/ impacts (negligible, minor, moderate, severe, major, catastrophic) associated and corresponding likelihood (likely, occasional, possible, unlikely, rare, remote) through stakeholder consultation. Identification of issues, evaluation of impacts and likelihood is done through workshops participated by all main stakeholders. Multiple of impacts and likelihood is considered as risk value for a given issue. Risk is evaluated against for categories, i.e. target species, by-product and other non-retained species, non-retained protected species, and ecosystem, habitat, based on pre-defined guidelines. According to the risks evaluated, existing management activities will be either maintained, adjusted, or enhanced with additional management activities.

The whole process is well organized but quite simple and easy to understand. Separation of evaluation guideline/ judgment criteria from actual identifications of issues, and evaluation of impacts and likelihood would facilitate to reach agreement and keep consistency. Though it is expected to take substantial amount of time and efforts to establish similar system suitable for the IOTC, even built upon the Australian experience.

The approach seems to be quite flexible, and the results of application are expected to largely depend on how management priorities would be set. The document shows the results reflecting the author's personal view, but only for the purpose of showing a process of the approach. In fact, this experimental application was only partially completed and is expected to carry quite many errors, inappropriate assignments, and inconsistency etc. Therefore, the results should not be taken as any meaningful indications in the context of fishery management.

Overall ERAEF outputs is available at together with CSIRO tools assisting quick PSA

<https://research.csiro.au/cor/research-domains/fisheries-domestic/ecological-risk-assessment/>

Proposed work plan to evaluate applicability and feasibility of ERAEF in IOTC context

This section describes a proposed work plan for evaluating an applicability and feasibility of the ERAEF in the context of the IOTC fisheries management on its relevant ecosystem in particular for the bycaught species impacted through the IOTC fisheries operations.

The proposal is to actually apply scoping and SICA process for small number of CPCs and their fisheries in a stepwise way, first conducted by experts based on their own knowledge and expertise followed by stakeholder consultations to modify, adjust, and refine the initial draft. The stepwise approach would also help in deepening the understanding on the ERAEF methodologies and indications of various criteria.

Although the scoping and SICA process need to be applied to whole fisheries and ecosystem, as an initial exploratory step, it is considered that the identifications of significant risks on manta rays could be one potential candidate as working objective from several reasons. First, manta rays is one of bycaught species not only whose interaction with and susceptibility to fisheries are poorly understood, but also the understandings on whose biology, behaviors and stock structure are not adequate. On the other hand, the rapid decline of local abundance was already noted, which requires prompt action to revert the current situation. The combination of least data availability and urgent need of management action would provide a serious challenge for a test-case but the expected impacts, if successful, would be also great. Secondary, while the exploratory application would need to limit the number of CPCs involved up to two or three, those CPCs that was identified to have fisheries with high occurrence of interaction with manta rays are relatively limited. Then, even small number of test-case application may result in the implication applicable to whole IOTC area. At the last but not least, the approach would provide a common basis required to establish EBFM, i.e. comprehensive understandings on likelihood and consequence



of all potential risks to bycaught species as well as target species and ecosystem as a whole, which is beneficial in particular when the participating CPCs intends to move toward EBFM.

For the purpose of this exploratory application of ERAEF, it is proposed for WPEB to establish a small core working group among with interested scientists, including those from the candidate CPCs for test-case application, those with expertise on focused species (e.g. manta rays) and those familiar with ERAEF and EBFM. The role of small core group includes i) to collaboratively develop tables and criteria required for scoping and SICA process, both initial draft and refinement afterwords; ii) actual implementation of scoping and SICA process, both initial draft preparation and through leading stakeholder consultation; iii) seeking for collaboration with managers, industries and other stakeholders, through informal communication at the Commission meeting and promotion of the concept to broader communities; and iv) active participation to compilation of results obtained, combined analysis and reporting.

The core working group need a support from the IOTC Secretariat, in particular on communication, coordination and organization of activities, financial and other administrative works and report preparation.

Proposed activities for the next three years are as follows:

Year 1 (2026-2027):

- WPEB:
 - establishment of small core group;
 - identification of test-case candidate CPCs;
 - securing financial support
- Inter-sessional period (core group):
 - on-line seminar by AFMA/ CSIRO experts, on their advice and learning from their experience;
 - development of initial draft of tables and criteria for scoping, if possible or needed, also start developing those for SICA;
 - establish agreement with the candidate CPCs on test-case application of scoping and SICA process;
 - exploratory scoping on the selected test-case CPCs, based on only expert knowledge
 - compile and analyze the results obtained from initial scoping, identifying issues and benefits, and prepare report for the forthcoming WPEB
- At the time of IOTC Commission meeting:
 - Piggyback event for introducing the concept and receiving feedback;
 - Informal consultation with managers and industries of test-case candidate CPCs on collaboration and arrangement to establish stakeholder consultations;

Year 2 (2027-2028):

- WPEB:
 - Review the progress and provide advice to the core group;
- Inter-sessional period (core group):
 - Refine the scoping tables and criteria based on the experience in the previous year
 - Develop table and criteria for SICA;
 - Conduct stakeholder consultations for completing scoping process, focusing on fulfilling gaps, and obtaining the initial ideas on management objectives and significant risks;
 - exploratory SICA on the selected test-case CPCs, based on only expert knowledge;



- compile and analyze the results obtained from final scoping and exploratory SICA, identifying issues and benefits, and prepare report for the forthcoming WPEB
- At the time of IOTC Commission meeting:
 - Piggyback event for promoting the concept, together with the output from initial exploratory scoping, and receiving feedback;
 - Informal consultation with managers and industries of test-case candidate CPCs on collaboration and arrangement to establish stakeholder consultations, and reporting the progress and results obtained;

Year 3 (2028-2029):

- WPEB:
 - Review the progress and provide advices to the core group;
 - Start discussion on potential values and problems of ERAEF;
- Inter-sessional period (core group):
 - Refine the scoping and SICA tables and criteria for scoping based on the experience in the previous years;
 - Conduct stakeholder consultations for completing SICA process, focusing on fulfilling gaps;
 - compile and analyse the results obtained from final scoping and SICA, and prepare the final report to present at the 2029 WPEB that should include identified list of significant risks on manta rays and their sources, issues and benefits of ERAEF approach, and suggestions on future management actions and research needs together with conclusion on applicability and feasibility of ERAEF in the IOTC context,
- At the time of IOTC Commission meeting:
 - Piggyback event for promoting the concept and reporting output from the test-case ERAEF application exercises;
 - Informal consultation with managers and industries of test-case candidate CPCs for reporting the progress and results obtained and getting their feedbacks;

The 2029 WPEB should review the outputs and evaluate the benefits, pros and cons, applicability and feasibility, and decide whether the ERAEF to be appropriate as basic management approach for bycatch and ecosystems susceptible to the IOTC fisheries. When it would decide to continue the exploratory effort, it should i) develop a work plan to expand to cover all relevant CPCs for manta rays; ii) decide whether it appropriate to expand the approach to other taxa, including other shark species; and when deciding positively iii) establish strategy for implementing the approach effectively avoiding duplication as much as possible.

The proposed activity would require substantial human resources and financial cost, in particular for those in the selected test-case candidate CPCs. Even those CPCs may benefit from this exercise for future development of EBFM as mentioned above, adequate support should be secured. It would be highly preferable to secure one dedicated consultant to lead and coordinate the whole exercise. Minimum 20 working days could work according to the level of assistance required to the test-case candidate CPCs.

Recommendation

To consider the implementation of the proposed work plan for three years to evaluate the feasibility of ERAEF in the IOTC context with appropriate level of financial arrangement.

Reference

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